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(72) Inventor; and
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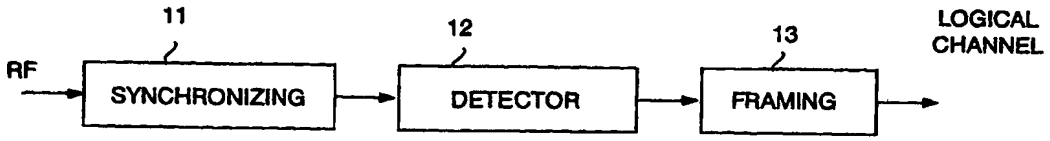
(74) Agent: KOLSTER OY AB; Iso Roobertinkatu 23, P.O. Box 148, FIN–00121 Helsinki (FI).

(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: DETECTION OF INTERFERING SIGNAL IN RADIO RECEIVER



(57) Abstract

A method and equipment for detecting an interfering signal in a time division multiple access (TDMA) radio receiver, in which case samples are taken (50) from a received signal in symbol sequences over a TDMA timeslot (20, 21, 22), a signal path corresponding to the TDMA timeslot, or a portion thereof, is generated by a modulation detector (12), an error estimate representing the erroneousness of the signal path generated is determined (51), the error estimate is compared (52) with a predetermined threshold value, and the reception of the interfering signal is recognized (53) if the error estimate is greater than the predetermined threshold value.

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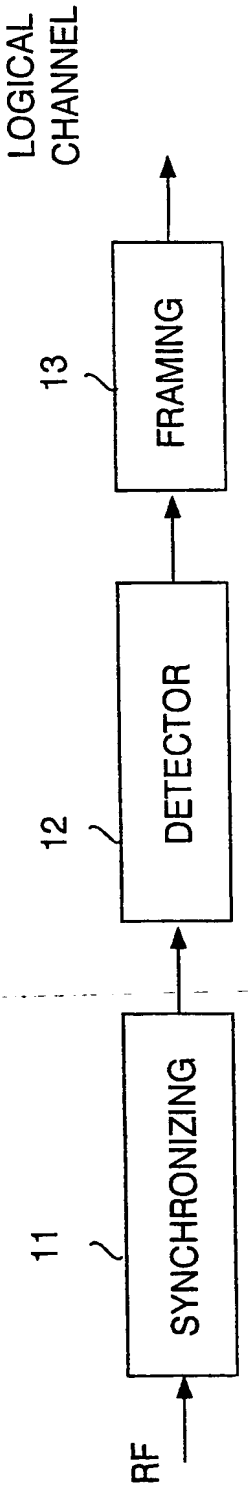
LOGICAL CHANNEL
13
FRAMING
12
DETECTOR
11
SYNCHRONIZING
RF

FIG. 1

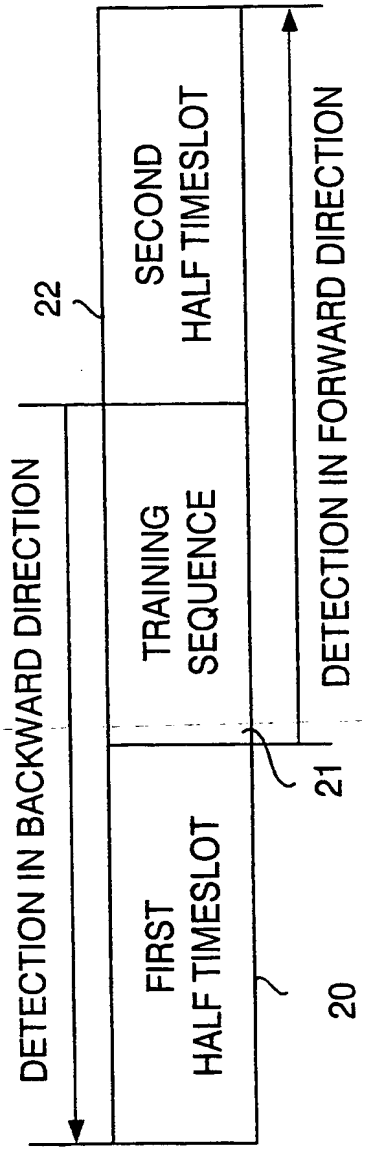
22
SECOND HALF TIMESLOT
TRAINING SEQUENCE
21
FIRST HALF TIMESLOT
20
DETECTION IN BACKWARD DIRECTION
DETECTION IN FORWARD DIRECTION

FIG. 2

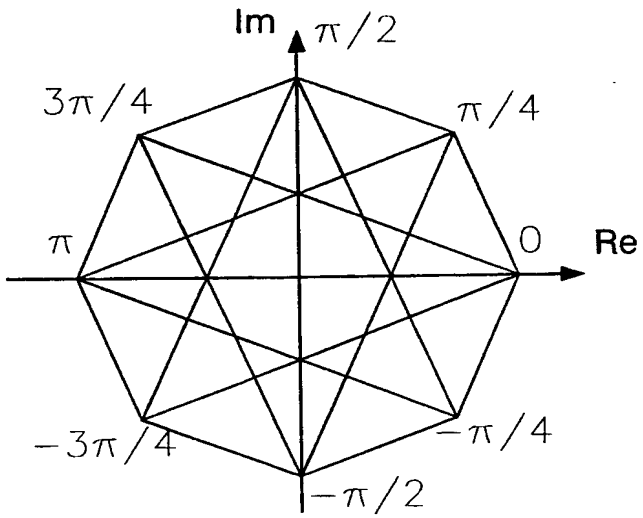

FIG. 3A

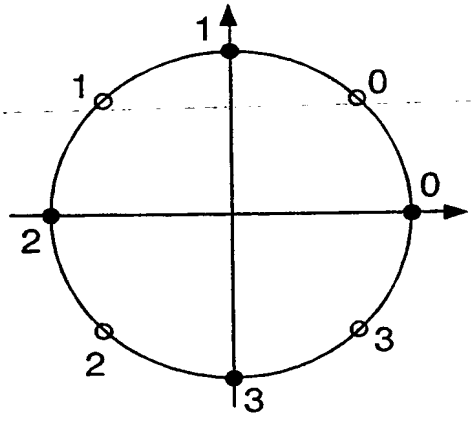

FIG. 3B

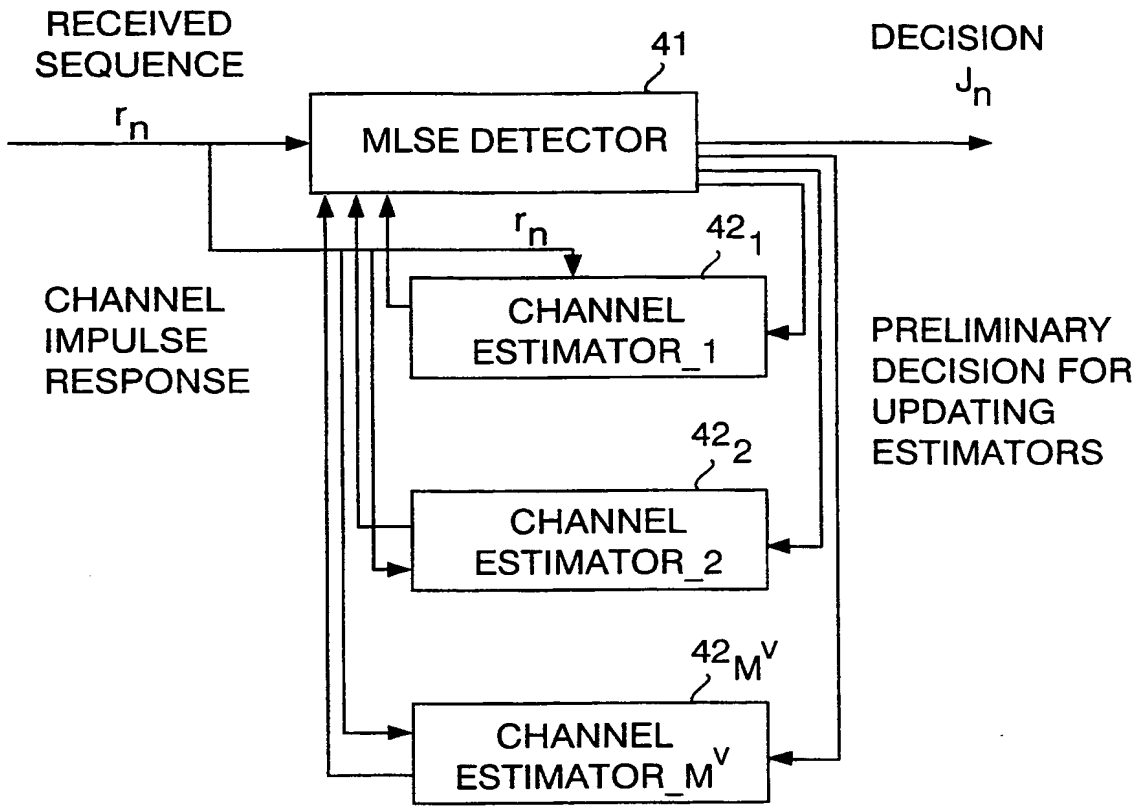
RECEIVED SEQUENCE
r_n
41
MLSE DETECTOR
DECISION
J_n
r_n
42_1
CHANNEL ESTIMATOR_1
CHANNEL IMPULSE RESPONSE
PRELIMINARY DECISION FOR UPDATING ESTIMATORS
42_2
CHANNEL ESTIMATOR_2
42_{M^v}
CHANNEL ESTIMATOR_M^v

FIG. 4

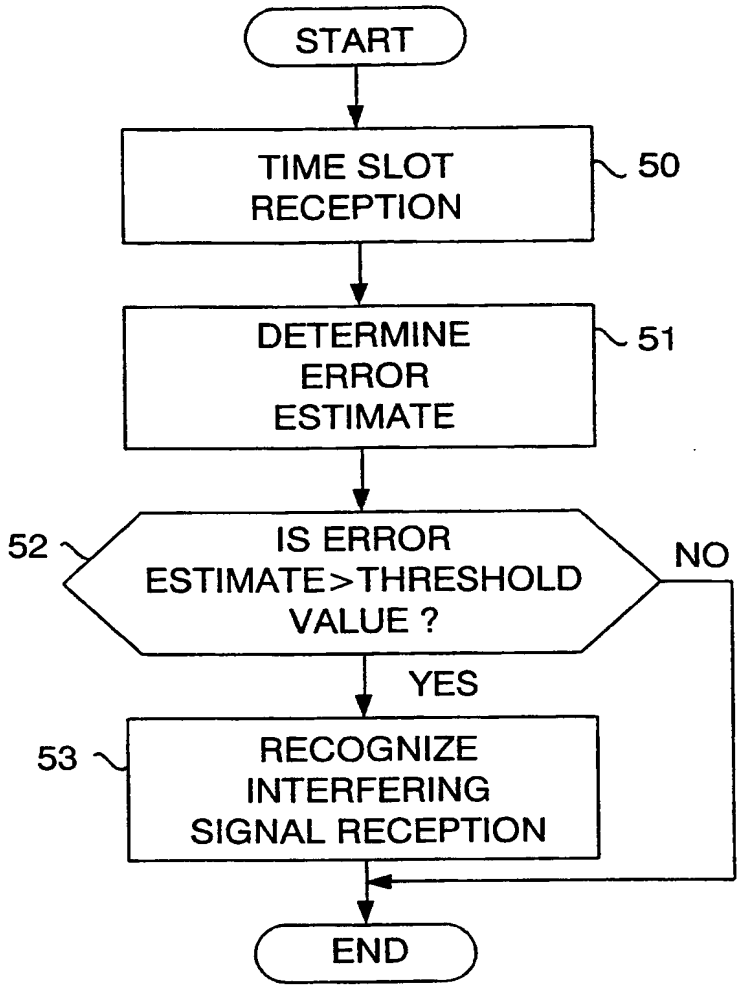
START
TIME SLOT RECEPTION
50
DETERMINE ERROR ESTIMATE
51
52
IS ERROR ESTIMATE>THRESHOLD VALUE ?
NO
YES
53
RECOGNIZE INTERFERING SIGNAL RECEPTION
END

FIG. 5

CLAIMS

1. A method of detecting an interfering signal in a time division multiple access (TDMA) radio receiver, **characterized** by in the method

taking samples from symbol sequences of a received signal over a TDMA timeslot,

generating by a modulation detector a signal path corresponding to the TDMA timeslot or a portion thereof,

determining an error estimate representing the erroneousness of the signal path generated,

comparing the error estimate with a predetermined threshold value, and

recognizing the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

2. A method as claimed in claim 1, **characterized** by using in the comparison an error estimate of a signal path corresponding to a half timeslot.

3. A method as claimed in claim 1 or 2, **characterized** by using a signal path error metric which is generated by means of quadratic errors which are calculated on the basis of individual symbol sequence specific sample points and reference constellation points corresponding thereto as the error estimate representing the erroneousness of the signal path.

4. A method as claimed in claim 1, 2 or 3, **characterized** by

generating two or more alternative signal paths from the received timeslot or a portion thereof by two or more parallel modulation detectors preferably of different types,

determining an error estimate of each signal path, and

selecting the signal path having the best error estimate to be used in the comparison.

5. Equipment for detecting an interfering signal in a time division multiple access (TDMA) radio receiver, **characterized** in that the equipment comprises

means for taking samples (50) from symbol sequences of a received signal over a TDMA timeslot and

a modulation detector (12) for generating a signal path corresponding to the TDMA timeslot (20, 21, 22) or a portion thereof, and that

the equipment is arranged to determine (51) an error estimate representing the erroneousness of the signal path generated and to compare (52) the error estimate with a predetermined threshold value, and that

the equipment is also arranged to recognize (53) the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

6. Equipment as claimed in claim 5, **characterized** in that it is arranged to use in the comparison (52) an error estimate of a signal path corresponding to a half timeslot (20 or 22).

7. Equipment as claimed in claim 5 or 6, **characterized** in that a signal path error metric which is generated by means of quadratic errors calculated on the basis of individual symbol sequence specific sample points and reference constellation points corresponding thereto is used as the error estimate representing the erroneousness of the signal path.

8. Equipment as claimed in claim 5, 6 or 7, **characterized** in that it comprises two or more parallel modulation detectors preferably of different types for generating two or more alternative signal paths from the received timeslot or a portion thereof, the equipment being arranged to determine an error estimate of each signal path and to select the signal path having the best error estimate to be used in the comparison.

RECORD COPY

PCT REQUEST

2980168PC/ko

Original (for SUBMISSION) - printed on 24.05.1999 12:32:39 PM

0 0-1	For receiving Office use only International Application No.	PCT/FI99/00443
0-2	International Filing Date	24 MAY 1999 (24.05.99)
0-3	Name of receiving Office and "PCT International Application"	The Finnish Patent Office PCT International Application
0-4 0-4-1	Form - PCT/RO/101 PCT Request Prepared using	PCT-EASY Version 2.83 (updated 01.03.1999)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	National Board of Patents and Registration (Finland) (RO/FI)
0-7	Applicant's or agent's file reference	2980168PC/ko
I	Title of invention	DETECTION OF INTERFERING SIGNAL IN RADIO RECEIVER
II II-1 II-2 II-4 II-5 II-6 II-7	Applicant This person is: Applicant for Name Address: State of nationality State of residence	 applicant only all designated States except US NOKIA TELECOMMUNICATIONS OY Keilalahdentie 4 FIN-02150 Espoo Finland FI FI
III-1 III-1-1 III-1-2 III-1-4 III-1-5 III-1-6 III-1-7	Applicant and/or inventor This person is: Applicant for Name (LAST, First) Address: State of nationality State of residence	 applicant and inventor US only HUTTUNEN, Mikko Teirintie 9 D 8 FIN-02770 Espoo Finland FI FI

PCT REQUEST

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IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	KOLSTER OY AB
IV-1-2	Address:	Iso Roobertinkatu 23 P.O.Box 148 FIN-00121 Helsinki Finland
IV-1-3	Telephone No.	358 9 618 821
IV-1-4	Facsimile No.	358 9 602 244
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW SD SZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AL AM AT (patent and utility model) AU AZ BA BB BG BR BY CA CH&LI CN CU CZ (patent and utility model) DE (patent and utility model) DK (patent and utility model) EE (patent and utility model) ES FI (patent and utility model) GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK (patent and utility model) SL TJ TM TR TT UA UG US UZ VN YU ZA ZW

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V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	**Exclusion(s) from precautionary designations**	NONE	
VI-1	**Priority claim of earlier national application**		
VI-1-1	Filing date	25 May 1998 (25.05.1998)	
VI-1-2	Number	981152	
VI-1-3	Country	FI	
VI-2	**Priority document request** The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1	
VII-1	**International Searching Authority Chosen**	Swedish Patent Office (ISA/SE)	
VIII	**Check list**	number of sheets	electronic file(s) attached
VIII-1	Request	4	–
VIII-2	Description	7	–
VIII-3	Claims	2	–
VIII-4	Abstract	1	2980168pc.txt
VIII-5	Drawings	4	–
VIII-7	TOTAL	18	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	–
VIII-9	Separate signed power of attorney	✓	–
VIII-10	Copy of general power of attorney	✓	–
VIII-16	PCT-EASY diskette	–	diskette
VIII-18	**Figure of the drawings which should accompany the abstract**	1	
VIII-19	**Language of filing of the international application**	English	
IX-1	**Signature of applicant or agent**	Klaus Roitto	
IX-1-1	Name	KOLSTER OY AB	

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10-1	**Date of actual receipt of the purported international application**	24 MAY 1999	(24 -05- 1999)
10-2	**Drawings:**		
10-2-1	Received		
10-2-2	Not received		

10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	

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11-1	Date of receipt of the record copy by the International Bureau	

INTERNATIONAL SEARCH REPORT

Inter onal application No.
PCT/FI99/00443

Box I **Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 2-3, 6-7
because they relate to subject matter not required to be searched by this Authority, namely:

See next page

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

The claims 2-3 and 6-7 are not considered to be clear and concise and they are not considered to be fully supported in the description (see PCT articles 6 and 17).

In claims 2 and 6, it is uncertain if the applicant means that the half timeslot is a predetermined sequence or not.

In claims 3 and 7, it is unclear what the applicant means by using symbol sequence specific sample points and reference constellation points for calculating the error.

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/11/99

International application No.
PCT/FI 99/00443

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9801959 A1	15/01/98	AU 3346697 A	02/02/98
		EP 0920734 A	09/06/99
		FI 103539 B	00/00/00
		FI 962736 A	04/01/98
		NO 986214 A	26/02/99
US 5363412 A	08/11/94	CA 2128881 A	07/07/94
		EP 0632947 A	11/01/95
		FI 943756 A	15/08/94
		JP 7504311 T	11/05/95
		KR 9707617 B	13/05/97
		WO 9415427 A	07/07/94
WO 9611533 A2	18/04/96	AU 697708 B	15/10/98
		AU 3654795 A	02/05/96
		EP 0784887 A	23/07/97
		FI 102797 B	00/00/00
		FI 944736 A	08/04/96
		JP 10507598 T	21/07/98
		NO 971545 A	04/06/97
US 5323421 A	21/06/94	AU 656487 B	02/02/95
		AU 4927393 A	26/04/94
		BR 9305648 A	13/06/95
		CA 2120714 A,C	14/04/94
		CN 1095534 A	23/11/94
		DE 4394943 C	23/05/96
		JP 7501678 T	16/02/95
		KR 9704774 B	03/04/97
		MX 9306057 A	31/03/94
		WO 9408402 A	14/04/94

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00443

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04B 1/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9801959 A1 (NOKIA TELECOMMUNICATIONS OY), 15 January 1998 (15.01.98), page 2, line 24 - page 3, line 2	1,5
A	--	4,8
A	US 5363412 A (ROBERT T. LOVE ET AL), 8 November 1994 (08.11.94), column 4, line 66 - line 68; column 5, line 1 - line 8; column 5, line 36 - line 43	4,8
	--	
A	WO 9611533 A2 (NOKIA TELECOMMUNICATIONS OY), 18 April 1996 (18.04.96), see whole document	1,4,5,8
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 November 1999	18 -11- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Michel Gascoin/ci Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00443

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5323421 A (CHRISTOPHER P. LAROSA ET AL), 21 June 1994 (21.06.94), see whole document -- --------	1,4,5,8

PATENT COOPERATION TREATY

-8 -11- 1999

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

KOLSTER OY AB
Iso Roobertinkatu 23
P.O. Box 148
FIN-00121 Helsinki
FINLANDE

Date of mailing (day/month/year)
01 November 1999 (01.11.99)

Applicant's or agent's file reference
2980168PC/ko

IMPORTANT NOTIFICATION

International application No.
PCT/FI99/00443

International filing date (day/month/year)
24 May 1999 (24.05.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
NOKIA TELECOMMUNICATIONS OY
Keilalahdentie 4
FIN-02150 Espoo
Finland

State of Nationality: FI
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address
NOKIA NETWORKS OY
Keilalahdentie 4
FIN-02150 Espoo
Finland

State of Nationality: FI
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[X] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[ ] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
Catherine Massetti
Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 17 February 2000 (17.02.00)	
International application No. PCT/FI99/00443	**Applicant's or agent's file reference** 2980168PC/ko
International filing date (day/month/year) 24 May 1999 (24.05.99)	**Priority date** (day/month/year) 25 May 1998 (25.05.98)
Applicant HUTTUNEN, Mikko	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

22 December 1999 (22.12.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer C. Villet
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
2980168PC		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/FI99/00443	24.05.1999	25.05.1998
International Patent Classification (IPC) or national classification and IPC7		
H 04 B 1/10		
Applicant		
Nokia Networks OY et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
22.12.1999	22.05.2000
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88 Telex 17978 PATOREG-S	Authorized officer Jesper Bergstrand/CL Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/FI99/00443

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages 1-7, as originally filed,
pages _____, filed with the demand,
pages _____, filed with the letter of _____,
pages _____, filed with the letter of _____.

☒ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. 1-8, filed with the letter of 22.12.1999,
Nos. _____, filed with the letter of _____.

☒ the drawings, ~~sheets~~/fig 1-5, as originally filed,
~~sheets~~/fig _____, filed with the demand
~~sheets~~/fig _____, filed with the letter of _____,
~~sheets~~/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/FI99/00443

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-8	YES
	Claims		NO
Inventive step (IS)	Claims	1-8	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-8	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates to a method of and equipment for detecting an interfering signal by means of an error estimate representing the erroneousness of the signal path generated by a modulation detector and corresponding to a received TDMA timeslot or a portion thereof.

The following documents are cited in the International Search Report:

D1: WO9801959 A
D2: US5363412 A
D3: WO9611533 A
D4: US5323421 A

The invention according to claims 1 and 5 comprises a method of and equipment for detecting an interfering signal in a TDMA radio receiver, where samples are taken from symbol sequences of a received signal over a TDMA timeslot and where a signal path corresponding to the TDMA timeslot is generated by a modulation detector. An error estimate representing the erroneousness of the signal path generated is determined and compared to a threshold value. The reception of the interfering signal is thereafter recognized if the error estimate is greater than the threshold value.
Document D1 describes a method used in a digital cellular radio system (page 2, line 4-line 5), like GSM (page 3, line 35), where samples are taken from symbol sequences (page 1, line 18-line 23). An estimation of multipath channels is also performed (page 5, line 10). However, no determining of an error estimate representing the erroneousness of the signal path generated and thereafter comparing this estimate with a threshold for deciding if the reception of an interfering signal should be recognized or not is performed.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

Document D2 describes a method and apparatus of adaptive maximum likelihood sequence estimation using filtered correlation synchronization.

Document D3 describes signal detection in a TDMA system.

Document D4 describes a method and apparatus of estimating channel quality in a receiver.

None of these documents discloses any information regarding determining of an error estimate representing the erroneousness of the signal path generated and thereafter comparing this estimate with a threshold for deciding if the reception of an interfering signal should be recognized or not.
The invention according to claims 1-8 is thus novel and considered to involve an inventive step.

CLAIMS

1. A method of detecting an interfering signal in a time division multiple access (TDMA) radio receiver, **characterized** by in the method

taking samples from symbol sequences of a received signal over a TDMA timeslot,

generating by a modulation detector a signal path corresponding to the TDMA timeslot or a portion thereof,

determining an error estimate representing the erroneousness of the signal path generated,

comparing the error estimate with a predetermined threshold value, and

recognizing the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

2. A method as claimed in claim 1, **characterized** by using in the comparison an error estimate of a signal path corresponding to a half timeslot.

3. A method as claimed in claim 1 or 2, **characterized** by using a signal path error metric which is generated by means of quadratic errors which are calculated on the basis of the difference between individual symbol sequence specific sample points and corresponding reference constellation points constructed on the basis of the channel estimate describing the state of the radio channel used as the error estimate representing the erroneousness of the signal path.

4. A method as claimed in claim 1, 2 or 3, **characterized** by

generating two or more alternative signal paths from the received timeslot or a portion thereof by two or more parallel modulation detectors preferably of different types,

determining an error estimate of each signal path, and

selecting the signal path having the best error estimate to be used in the comparison.

5. Equipment for detecting an interfering signal in a time division multiple access (TDMA) radio receiver, **characterized** in that the equipment comprises

means for taking samples (50) from symbol sequences of a received signal over a TDMA timeslot and

a modulation detector (12) for generating a signal path corresponding to the TDMA timeslot (20, 21, 22) or a portion thereof, and that

the equipment is arranged to determine (51) an error estimate representing the erroneousness of the signal path generated and to compare (52) the error estimate with a predetermined threshold value, and that

the equipment is also arranged to recognize (53) the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

6. Equipment as claimed in claim 5, **characterized** in that it is arranged to use in the comparison (52) an error estimate of a signal path corresponding to a half timeslot (20 or 22).

7. Equipment as claimed in claim 5 or 6, **characterized** in that a signal path error metric which is generated by means of quadratic errors calculated on the basis of the difference between individual symbol sequence specific sample points and corresponding reference constellation points constructed on the basis of the channel estimate describing the state of the radio channel used is used as the error estimate representing the erroneousness of the signal path.

8. Equipment as claimed in claim 5, 6 or 7, **characterized** in that it comprises two or more parallel modulation detectors preferably of different types for generating two or more alternative signal paths from the received timeslot or a portion thereof, the equipment being arranged to determine an error estimate of each signal path and to select the signal path having the best error estimate to be used in the comparison.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2980168PC	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/FI99/00443	International filing date *(day/month/year)* 24.05.1999	Priority date *(day/month/year)* 25.05.1998
International Patent Classification (IPC) or national classification and IPC7 H 04 B 1/10		
Applicant Nokia Networks OY et al		

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	Claims		NO
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	Claims		NO
Industrial applicability (IA)	Claims	1-8	YES
	Claims		NO

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.../...

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comparing the error estimate with a predetermined threshold value, and

recognizing the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

2. A method as claimed in claim 1, **characterized** by using in the comparison an error estimate of a signal path corresponding to a half timeslot.

3. A method as claimed in claim 1 or 2, **characterized** by using a signal path error metric which is generated by means of quadratic errors which are calculated on the basis of individual symbol sequence specific sample points and reference constellation points corresponding thereto as the error estimate representing the erroneousness of the signal path.

4. A method as claimed in claim 1, 2 or 3, **characterized** by

generating two or more alternative signal paths from the received timeslot or a portion thereof by two or more parallel modulation detectors preferably of different types,

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a modulation detector (12) for generating a signal path corresponding to the TDMA timeslot (20, 21, 22) or a portion thereof, and that

the equipment is arranged to determine (51) an error estimate representing the erroneousness of the signal path generated and to compare (52) the error estimate with a predetermined threshold value, and that

the equipment is also arranged to recognize (53) the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

6. Equipment as claimed in claim 5, **characterized** in that it is arranged to use in the comparison (52) an error estimate of a signal path corresponding to a half timeslot (20 or 22).

7. Equipment as claimed in claim 5 or 6, **characterized** in that a signal path error metric which is generated by means of quadratic errors calculated on the basis of individual symbol sequence specific sample points and reference constellation points corresponding thereto is used as the error estimate representing the erroneousness of the signal path.

8. Equipment as claimed in claim 5, 6 or 7, **characterized** in that it comprises two or more parallel modulation detectors preferably of different types for generating two or more alternative signal paths from the received timeslot or a portion thereof, the equipment being arranged to determine an error estimate of each signal path and to select the signal path having the best error estimate to be used in the comparison.

PATENTTI- JA REKISTERIHALLITUS

VÄLIPÄÄTÖS

21.05.99

Kolster Oy Ab

Iso Roobertinkatu 23

00120 Helsinki

Patenttihakemus nro:	981152
Luokka:	H 04B / JJK / JJR
Hakija:	Nokia Telecommunications Oy
Asiamies:	Kolster Oy Ab
Asiamiehen viite:	2980168FI
Määräpäivä	21.11.99

Patenttihakemuksen numero ja luokka on mainittava kirjelmässänne PRH:lle

Uutuustutkimuksessa on löytynyt patentoitavuuden esteitä menetelmälle häiritsevän signaalin havaitsemiseksi aikajakomonikäytössä (TDMA)-radiovastaanottimessa.

Patentoitavuuden esteenä mainitaan JP hakemusjulkaisu 9083590 (H04L27/22), jossa signaalien symbolijaksoista tehdään korrelaatiovertailua häiriöiden havaitsemiseen ja poistamiseen. Tämän kanssa esitetään US hakemusjulkaisu 5809009 (H04J3/06), joka on tullut tämän hakemuksen tekemisen jälkeen julkiseksi.

Tekniikan tasona mainitaan EP hakemusjulkaisu 0671836 (H04L25/03), jossa esitetään MLE IC-piiri digitaalisen datan interferenssihäiriöiden estimoimiseksi.

Lisäksi tekniikan tasona mainitaan GB hakemusjulkaisu 2250667 (H04L25/03), jossa esitetään TDMA vastaanottimessa laite aikahajonnan ja monitie häiriöiden poistamiseksi.

Tutkijainsinööri
Puhelin: (09) 69395243

Tapani Salonen

Lausumanne huomautusten johdosta on annettava viimeistään yllämainittuna määräpäivänä. Jollette ole antanut lausumaanne virastoon viimeistään mainittuna määräpäivänä tai ryhtynyt toimenpiteisiin tässä välipäätöksessä esitettyjen puutteellisuuksien korjaamiseksi, jätetään hakemus sillensä (patenttilain 15 §). Sillensä jätetty hakemus otetaan uudelleen käsiteltäväksi, jos Te neljän kuukauden kuluessa määräpäivästä annatte lausumanne tai ryhdytte toimenpiteisiin esitettyjen puutteellisuuksien korjaamiseksi ja samassa ajassa suoritatte vahvistetun maksun, 320 mk hakemuksen ottamisesta uudelleen käsiteltäväksi. Jos lausumanne on annettu virastoon oikeassa ajassa, mutta esitettyjä puutteellisuuksia ei ole siten korjattu, että hakemus voitaisiin hyväksyä, se hylätään, mikäli virastolla ei ole aihetta antaa Teille uutta välipäätöstä (patenttilain 16 §). Uusi keksinnön selitys, siihen tehdyt lisäykset ja uudet patenttivaatimukset on aina jätettävä kahtena kappaleena ja tällöin on otettava huomioon patenttiasetuksen 19 §.

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PATENTTI- JA REKISTERIHALLITUS **TUTKIMUSRAPORTTI**
Patentti- ja innovaatiolinja

PATENTTIHAKEMUS NRO	LUOKITUS
981152	H04B14/06, H04B17/00, H04L27/22

TUTKITTU AINEISTO

Patenttijulkaisukokoelma (FI, SE, NO, DK, DE, CH, EP, WO, GB, US), tutkitut luokat

H04B14/06, H04B17/00, H04L25/03, H04L27/22

Tiedonhaut ja muu aineisto

EPOQUE tietokannat EPODOC, WPI, PAJ, fulltext tietokannat englisht, germant, frencht

VIITEJULKAISUT

Kategoria*)	Julkaisun tunnistetiedot	Koskee vaatimuksia
A	GB-A-2250667, H04L25/03, Motorola Inc.	1,5
A	EP-A-0671836, H04L25/03, Intracom A E	1,5
X	JP-A-9083590, H04L27/22, Matsushita Electric Inc. Co Ltd.	1,5
X (uusi)	US-A-5809009, H04J3/06, Matsushita Electric Inc. Co Ltd.	1,5

*) X Patentoitavuuden kannalta merkittävä julkaisu yksinään tarkasteltuna
Y Patentoitavuuden kannalta merkittävä julkaisu, kun otetaan huomioon tämä ja yksi tai useampi samaan kategoriaan kuuluva julkaisu
A Yleistä tekniikan tasoa edustava julkaisu, ei kuitenkaan patentoitavuuden este

Päiväys	Tutkija
21.5.1999	Jari Rantala